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ABSTRACT

Educational Resources Information Center (ERIC) publications and ncn-ERIC publications were reviewed and analyzed to identify major findings, promising developments, strategies, and methodclogical strengths and weaknesses which exist in curricula designed fcr preparing transportation workers in transportation transport, and railroad occupaticns. There is a need for workers in transportaticn cccupations, but sources of formal training are often limited or ncnexistent. The need fcr wcrkers and the limited availability cf training emphasize the need for reassessing priorities in planning educational programs. While curricula and curriculum materials are available for certain cccupations, improvements are needed and changes will be necessary. To accomplish improvements and changes, curricula should be developed and evaluated through an educational planning system involving occupational analysis, prcgram planning, program development and testing, and documentation and dissemination of results. In addition to curricula, improved recruiting and counseling materials as well as expansion cf present programs will be required. (SB)

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review and analysis
of curricula for

OCCUPATIONS IN TRANSPORTATION

ERIC

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REVIEW AND ANALYSIS OF CURRICULA FOR OCCUPATIONS IN TRANSPORTATION

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PREFACE

This *Review and Analysis of Curricula for Occupations in Transportation* is one of a series of information analysis papers in vocational and technical education and related fields. It should aid curriculum development specialists, researchers, and practitioners in assessing the current "state of the art" in the field. The compact nature of the review should be of assistance to practitioners in identifying current curriculum offerings and useful materials to improve operating programs. It should also assist in identifying voids in our present research and development framework and enhance future studies, both in terms of their substantive focus and methodological approaches.

Where ERIC document numbers and ERIC Document Reproduction Service (EDRS) prices are cited, the documents are available in microfiche and hard copy forms.

The profession is indebted to Wiley B. Lewis, Virginia Polytechnic Institute and State University, for his scholarship in the preparation of this report. Recognition is also due Arthur Jensen, director, Vocational Education Media Center, Clemson University; and Ronald Daugherty, curriculum specialist, The Center, for their critical review of the manuscript prior to its final revision and publication. J. David McCracken, information specialist at The Center, coordinated the publication's development.

Members of the profession are invited to suggest specific topics or problems for future reviews.

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INTRODUCTION

Transportation means the moving of people and materials from one place to another. Occupations centered around this movement play an important role in the American economy. Job openings in these occupations are expected to show a rapid numerical increase during the 1970's because of an increasing concern toward attaining the national goals identified in *Goals for Americans, The President's Commission on National Goals* (1960).

Several socioeconomic, political, and technological factors are creating a need for personnel in these occupations. Among these factors, the most important are:

1. Technological advances occurring in all of the transportation occupations;
2. Concentration of metropolitan population growth in the suburbs;
3. Shifts in distribution of traffic between different modes of transportation;
4. Rising income levels of most American families and their increasing expectations for better transportation services and facilities; and
5. Government involvement in planning and implementing Federal transportation programs and in providing financial support.

These factors have contributed to the development of a need for additional transportation facilities and personnel to meet the growing demands for transportation workers. Decreasing the gap between the potentialities of modern transportation technologies and the availability of transportation services to Americans is an important national goal. However, the lack of an adequate supply of trained transportation manpower can prevent the attainment of high-priority national objectives in many fields.

Transportation job openings of interest in this analysis will involve the five occupational categories listed below (Teeple and Kenadjian, 1969).

1. Air Transport Occupations
2. Motor Vehicle Occupations
3. Pipeline Occupations
4. Railroad Occupations
5. Water Transport Occupations

Primary attention will be directed toward occupations in these categories which are unique to transportation operations, maintenance, and repair. Additional information concerning these categories and their component occupations may be obtained by referring to the *Dictionary of Occupational Titles, 1965* and its supplements.

A rapidly growing demand for transportation manpower coupled with the current situation of a slowly increasing supply has two principal implications for planning in vocational education. First, the rapid expansion in transportation services required to meet public and private needs means a parallel expansion in a broad spectrum of needs for trained transportation workers. Second, it implies an expanding base of job opportunities for individuals in the "left out" groups in American society.

Statement of the Problem

Projected demands for increased numbers of transportation workers have resulted in a need to synthesize information related to the training of skilled workers for transportation occupations with special emphasis directed toward curricula for emerging occupations. As new technological and scientific findings are developed, or as shifts occur in job performance patterns, many existing occupational curricula will require revision or completely new approaches. Thus, providing instruction in the occupational areas important in the 1970's will be a challenge to those persons responsible for the programs. This analysis of literature related to transportation occupations was undertaken in an effort to help these responsible individuals:

1. Assess the availability and current development of curricula, materials, and guides for their development and use;
2. Identify promising developments and findings in the transportation occupations; and
3. Identify and describe the major conclusions and future research and development alternatives.

To help in meeting these needs, the remainder of this report will be directed toward accomplishing the following objectives:

1. To determine if additional educational programs are needed, and if so, identify which occupational areas require instructional emphasis;
2. To determine if curricula and curriculum materials are presently available for use in preparing students for occupational areas identified as important;
3. To identify the techniques and procedures used for developing available curricula and for providing instruction; and
4. To identify the techniques and procedures which should be used for developing curricula and for providing instruction in the future.

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REVIEW AND ANALYSIS OF CURRICULA FOR OCCUPATIONS IN TRANSPORTATION

REVIEW AND ANALYSIS OF THE LITERATURE

Publications and documents listed in the bibliography were reviewed and analyzed in an effort to identify the major findings, promising developments, strategies, and methodological strengths and weaknesses which exist in curricula designed for preparing transportation workers. Such a review and analysis was believed to be important to those persons responsible for educational programs related to transportation occupations.

Need for Educational Programs

Creating and operating an efficient and progressive transportation system in the 1970's is expected to generate employment for 14 million persons in all occupations (Teeple and Kenadjian, 1969). However, something less than half of all employment in the field is represented by occupations which are unique to transportation operations, maintenance, and repair.

Estimates for the 1970's indicate annual openings for approximately 300,000 workers in unique transportation occupations (Teeple and Kenadjian, 1969). Sources of formal training for individuals who will fill these positions are often limited or nonexistent. This need for workers and the limited availability of training emphasize the need for reassessing priorities in planning programs in transportation education.

Over two-thirds of the projected employment will involve blue collar workers. This along with the relative absence of discriminatory barriers based on race in most large transportation occupations will aid economically and socially disadvantaged groups (Teeple and Kenadjian, 1969).

On the basis of available information, it is possible to rank the major occupational categories related to transportation operations, maintenance, and repair and their major component occupations according to the increased number of job openings expected between 1966 and 1975. Such a ranking would show that motor vehicle occupations were expected to have the greatest increase, followed by air transport occupations and railroad occupations. Only slight increases were anticipated in employment on ships or pipelines.

The general ranking of each of the selected occupations within the three principal categories is shown in Figure 1. It should be remembered that these rankings, based on projected numerical increases, were, and still are, subject to change because of changing conditions in the occupational areas. Widespread utilization of hydrofoils and air cushion vehicles could develop new occupations, while containerization and high speed passenger transportation could increase the demand for railroad workers. The present automobile engine is expected to be modified and used during the 1970's; but steam, electricity, or fuel cells could change many occupations related to the automobile. Though such changes are possible, rankings such as those in Figure 1 should prove of value in planning vocational education programs since occupational growth generally will deal with present jobs. Based upon information available as a result of the various

literature searches, it was concluded that as was implied in an Oregon study (*Oregon Statewide Study of Systematic Vocational Education Planning, Implementation, Evaluation: Phase I—Manpower Needs, Data-Collection Devices and Occupational Clusters. Final Report,* 1967), future transportation jobs are, in all likelihood, not going to be measurably different than those that now exist.

In addition to the specific occupations listed in Figure 1, current emphasis which is being placed on highway safety programs by the Federal government (U.S. Department of Transportation, September 1969) is likely to expand to other modes of transportation. If this occurs, individuals trained specifically for safety considerations may offer employment opportunities of major importance. However, the absence of information related to these occupations in the literature searched led the writer to terminate consideration of these occupations.

Current training programs come closer to meeting immediate needs in some occupational areas, auto mechanics, for example, than in others such

FIGURE 1
RANKINGS OF SELECTED TRANSPORTATION OCCUPATIONS ACCORDING TO EXPECTED ANNUAL NUMERICAL INCREASES IN JOB OPENINGS, 1966-1975*

1. MOTOR VEHICLE OCCUPATIONS
   a. Truck and Tractor Drivers
   b. Deliverymen and Routemen
   c. Auto Mechanics and Repairmen
   d. Auto Service and Parking Attendants
   e. Taxi Drivers and Chauffeurs
   f. Bus Drivers
2. AIR TRANSPORT OCCUPATIONS
   a. Airplane Mechanics
   b. Airplane Pilots and Navigators
   c. Air Controllers
3. RAILROAD OCCUPATIONS
   a. Brakemen and Switchmen
   b. Locomotive Engineers

* Prepared on the basis of information presented by Teeple and Kenadjian, 1969 and presented in *Manpower Requirements for Air Traffic Control and Flight Service Specialists in Indiana.*

as airplane mechanics and truck drivers (Teeple and Kenadjian, 1969). However, the low ratio of training completions to anticipated job openings in each of the categories listed earlier indicates a need for additional educational emphasis. This condition creates a presumption that sizeable returns would be likely to result from a considerably greater concentration of effort on programs in each of these fields.

This presumption was reinforced by Lecht (1968) who indicated that, based on the projected percentage of increase in employment, auto service and parking attendants and deliverymen and routemen are in high growth occupations. In addition, he indicated that auto mechanics and repairmen, other mechanics, and truck and tractor drivers are in moderate growth occupations while painters are in a low growth occupation. Similar trends were reported in a study, *Occupational Employment Patterns for 1960 and 1975* (U.S. Department of Labor, Bureau of Labor Statistics, 1968), sponsored by the Manpower Administration.

One should note that while there is an apparent conflict between the information provided by Lecht (1968) and that shown in Figure 1, the conclusions were based on different criteria. Lecht (1968) considered the projected percentage of increase in employment while the rankings in Figure 1 were based on expected annual numerical increases in the number of job openings. Educators should consider both the rate of growth and the total growth in planning educational programs related to transportation occupations.

Since the occupations for which preparation will be needed have been identified in a general manner, consideration should be given to the individuals who will receive such preparation. As one might expect, vocational education related to transportation occupations has been provided for secondary and post-high school or adult students. But the only courses of major importance for the high school student were auto mechanics courses while other courses generally were offered at the adult or post-secondary level.

Pre-employment education which is often provided can ensure a certain standard of competence on entry into an occupation and the individual can learn about an occupation before committing himself to employment or further training. Post-employment training helps the individual to improve his skills to retain his job, advance in his present job, or qualify for a new job. While there is a need for expanding both types of programs as related to transportation occupations and for all students, the national policy of increasing and upgrading employment opportunities for the disadvantaged suggests that a continued emphasis will be placed on adult programs in the transportation field.

In providing training for transportation occupations, vocational education as described in the Vocational Education Amendments of 1968 exists side by side with other training systems designed for preparing individuals for employment. These systems include programs conducted under the auspices of the Manpower Development and Training Act (MDTA), the Job Corps, the Armed Forces, post-high school institutions, proprietary

schools, and public and private agencies and through on-the-job training. But even with all of these systems, the number of trained workers is inadequate. Because of this and the relative high cost of training programs, vocational education will remain viable in this area. High school vocational courses can provide pre-employment training and can encourage students to remain in school and acquire educational credentials suitable for entrance into transportation occupations or other specialized training programs. Vocational education along with MDTA and Job Corps programs has provided and can continue to provide basic education and occupational training courses needed to serve the needs of unemployed workers or workers whose job skills have been made obsolete by economic and technological changes.

Teeple and Kenadjian (1969) reported a general lack of cooperative work-study programs in the transportation occupations. Since no literature was found during the searches which provided information concerning this type of program, educators should consider the values of this type of program.

While increased educational opportunities are imperative, it must be realized that a long period of time will be required before all workers entering transportation occupations have an opportunity to participate in some type of formal training. Efforts must be made to provide such training, for the general lack of educational programs related to each of these occupational areas may indicate a lack of foresight on the part of interested educators and other responsible persons associated with transportation occupations.

Curricula and Curriculum Materials

A curriculum is the "backbone" of the instructional process. It serves as a pattern or blueprint for education. Vocational instructors use it to chart the course from meager student interest and knowledge of a vocation or cluster of vocations to achievement of the goal of employment. The success of the instructional program is wrapped-up principally in the extent to which it contributes to this goal.

Because the curriculum is important, a common understanding of its meaning should be established. The term has been defined many ways, but according to Leighbody it "is the sum total of the learning experiences for which the school has responsibility, whether they occur in school or not" (*Papers Presented at the National Conference on Curriculum Development in Vocational and Technical Education,* 1969). The curriculum should provide an outline of the practical training and related instruction required for the acquisition of a specific level of skill and knowledge in a particular occupation or cluster of occupations. With this as a basis, appropriate literature was reviewed to determine the availability of curricula for transportation occupations. It should be noted that many of the documents reviewed as curricula were really multipurpose items which would fit also in the categories of curriculum guides and courses of study.

For transportation occupations, only a limited number of curricula were found and reviewed. Of this group, the majority of the items were related to motor vehicle occupations, especially those involving auto mechanics and repairmen. Few curricula were found relating to air transport occupations and none were reviewed which related to pipeline, rail, or water transport occupations.

Curricula reviewed were designed to be used for preparing students for a single occupation or a cluster of occupations. For example, *Guide for Course of Study for Auto Body Repairman (Entry)* was prepared by McDonough (1968) solely for the preparation of body repairmen; while Ullery and Forsyth's (1969) power mechanics curriculum was designed to provide for basic student needs in several occupational areas.

Curricula included in the review generally were designed for one of two groups—adults (pre-employment or post-employment) and high school students. Though instruction for the two groups is interrelated, the curriculum should be prepared for the type of student being served. *Auto Body and Fender Repair* (1969) was designed specifically for students in grades 11 and 12 while *Automotive Service Station Attendant (Driveway Salesman)* (1968) was prepared for adults.

This review and analysis of curricula revealed that such items were readily available for occupations related to auto mechanics and repairmen but generally lacking in the other areas. Specific efforts should be made to develop educational curricula in all occupational areas at the secondary and post-high school levels.

In addition, other curriculum materials were identified on the basis of Olivo's (Larson and Blake, 1969) definition of curriculum materials which states that "curriculum materials in vocational education refer to all the audio-visual sensory teaching-learning materials and devices used by the teacher and/or learner to teach or master effectively and efficiently the skills, technologies, and general areas of learning required as a worker and as a citizen."

Textbooks, workbooks, study guides, and instructional guides were found to be abundant in the literature relating to auto mechanics and repair occupations. Examples of programmed units were found to be lacking for all occupations; but two researchers, Rozran (1968) and Finch (1969), reported the use of such material for auto mechanics instruction. Only one publication dealing specifically with facility planning, *A Guide for Planning Facilities for Occupational Preparation Programs in Automotive Service* (Adams, 1967) was discovered.

While materials of this type were not available for pipeline or railroad occupations, limited items were available for air and water transport occupations. *Flight Maneuvers Manual for Instructors and Students* (1969), *Airman's Information Manual* (Winner, 1969), *Rigging Cargo Gear* (Netterstrom, 1966), and *Small Craft Operation and Navigation* (1960) are examples of those items available.

Though the National Automobile Dealers Association, the Automotive Trade Association Managers, and the Independent Garage Owners of America have established standards for training apprentices for auto

mechanics, repairmen, and painters which may be applied to vocational programs, no standards were found which were established specifically for vocational education programs. The Federal Aviation Administration (FAA) sets minimum criteria for course content and knowledge and skill acquisition for pilots and mechanics, and these may be used in curriculum development (*Civilian Pilot Training Skills, Curricula, and Costs,* 1968). Standards were not found and reviewed for the other occupational areas. However, it is believed that organizations related to the various occupations might provide valuable aid in the development of educational programs and materials.

One should not consider that such materials—curricula, curriculum materials or standards—do not exist if they are not included in the bibliography. In addition to the fact that the bibliography contains only a few selected items, many materials of this type were prepared locally and/or on a limited budget and were not available for distribution. Too, according to Leighbody, there is no way to know how much instructional material of this kind—syllabi or content documents—exists because it is not usually available for distribution (*Papers Presented at the National Conference on Curriculum Development in Vocational and Technical Education,* 1969). This lack of distribution may have caused a duplication of effort in that other persons had to prepare similar materials so they would be available for immediate use. The probability of such duplication was observed in several of the transportation occupational areas, especially auto mechanics. If extra effort was required, one should consider that it is generally recommended that those persons associated with the program should participate in developing the required curriculums. If teachers are to contribute as they should to curriculum improvement, they must participate, on a continuing basis, in curriculum development. But such development is not the teacher's task alone. A team composed of teachers of related subjects, researchers, and specialists from the field of work should be involved (*A Guide for the Development of Curriculum in Vocational and Technical Education,* 1969).

Reports of research studies were reviewed in which curriculum materials other than printed matter played an important role in transportation training programs (Finch, 1969 and Rozran, 1968). In addition, several other documents included suggested films and other instructional aids which might be used to advantage (*Automotive Mechanic Entry* from U.S. Department of Health, Education, and Welfare, 1969 and *Suggested Guidelines for Developing a High School Trade and Industrial Program in Automotive Body and Fender Repair,* 1967). However, the limited references to materials such as films, television systems, projectors, and transparencies in the literature searches lead one to conclude that "the media have been treated as addenda, as interesting appendages, instead of as the bricks from which actual curricula experiences are built" (Finn and Others, 1967).

Caution should be exercised in selecting and using materials related to these occupations. Each of the items reviewed was prepared for use

with specific groups of people and this must be considered. Furthermore, consideration should be given to the fact that while many of the items reviewed were prepared only a few years ago, technological developments may have resulted in these publications containing inaccurate information.

One should note also the wide variety of sources responsible for the preparation of the curricula and curriculum materials. Though educational institutions were responsible for much of the material reviewed, organizations associated with transportation occupations, publishing houses, and governmental agencies also made a great contribution. Because of the many sources from which such materials may be obtained, care should be exercised to secure instructional material from a reliable and competent source.

Curriculum Development

In developing curricula for new and emerging transportation occupations, one should use past practices and procedures of curriculum development as a basis. To identify these practices and procedures, it was considered necessary to review curricula, curriculum materials, and research reports. In addition, an attempt was made during this review to discover needed revisions in these procedures and techniques.

Analyses for Curriculum Development

Larson (1969) indicated that "curriculum development based on employment needs is the essence of effective payroll education for the youth and adult in today's world." Since this belief generally is accepted by vocational educators, job analysis has been used for many years as the basis for curriculum development in vocational education.

Because of continued and increasing employment needs, job analysis—the process of studying the operations, duties, and organizational relationships of jobs to obtain data for reporting the significant worker's activities and requirements—will continue to be an important part of such development. However, such analysis will be conducted under stricter guidelines and controls. The use of functional job analysis in the design and evaluation of vocational-technical education curricula was discussed by Yagi and his associates (1968) in their publication, *The Design and Evaluation of Vocational Technical Education Curricula Through Functional Job Analysis.*

A second type of analysis which has been used in developing curricula for transportation occupations is task analysis. This type of analysis is a method or a process by which a task, a subunit of a job, is examined and its characteristics, in terms of certain attributes, are identified. Chenzoff defined a task as a "collection of activities that are; performed by one person, bounded by two events, directed toward achieving a single objective or output, and describable by means of the method set forth so that the resulting task description conveys enough information about the task to permit the necessary training decisions to be made" (Larson, 1969). Allen and Others (1966) reported using this procedure for curriculum development in aviation mechanics. Use of this technique was also reported in the

publication *Oregon Statewide Study of Systematic Vocational Education Planning, Implementation, Evaluation: Phase I—Manpower Needs, Data-Collection Devices and Occupational Clusters. Final Report* (1967). For persons interested in this type of analysis, this latter publication and an earlier report, *Oregon Statewide Study of Systematic Vocational Education Planning, Implementation, Evaluation: Phase I—Manpower Needs, Data-Collection Devices and Occupation Clusters. Exhibit A* (1965), should be reviewed.

The third type of analysis which sometimes is used for developing curricula is occupational analysis. This analysis involves techniques similar to those of job or task analysis but the scope of the research is much greater. Occupational analysis has been described by Borow as the application of a systematic method of obtaining information focused on occupations and industries as well as on jobs, tasks, and positions (Larson, 1969).

In reviewing and analyzing the techniques used in developing available curricula, this writer generally found it difficult to establish clear differences between the procedures which were reported as being used. This agrees with Larson's (1969) statement that positive distinctions between and among the characteristics of the various systems of analysis are often difficult to establish, primarily because of the overlapping in the application of terms.

Tuckman (1968) has introduced another type of analysis—structural analysis. This type of analysis is a systematic approach to curriculum development representing an attempt to organize terminal performance objectives for a unit of subject matter into a sequence of prerequisite competencies which must be satisfactorily mastered if successful performance is to occur. It involves asking the question: "What competencies must a person already possess in order to obtain a satisfactory performance level on some specified objective, given no instruction beyond those definitions specific to the objective in question?" By asking this question of all identified competencies, a hierarchy of requisite competencies is generated which parallels the learning process appropriate to the final task.

Regardless of which type of analysis is selected for a particular situation, it is evident that analyses have been used as bases for analyzing the work performed by individuals in transportation occupations. But how is data for such analyses collected? Again, the curricula reviewed and analyzed revealed that a variety of methods were used. These methods included mail surveys, interviews, observations, analyses of documents such as curricula and textbooks, and committees composed of persons associated with the occupation or occupations. The major portion of the curricula reviewed was developed by securing analysis information from educators and/or administrators and having the results reviewed by a specialist in the occupational area or areas. While this type of analysis has proved effective in the past, more sophisticated methods will be employed in the future.

Systems Approach

To expand the usefulness of the various analyses described above, curriculum building in vocational education is taking on a systems approach. The analyses described earlier will be incorporated into a systems approach—"a 'closed-loop' analytic and developmental process which can be utilized to continuously: 1) assess the results of performance, 2) maintain sensitivity to performance requirements, and 3) provide for the self-correction of performance in order that the specified objectives can be achieved" (Miller, 1967). This approach involves analysis and further extends the development process by requiring performance objectives along with educational strategy to meet these objectives. The systems approach also requires that selection criteria for students be established. According to Miller (1969), this final step is important, for unless the student has the proper educational background and personality characteristics, the drop-out rate will be high. Mager and Beach (1967) recognized the value of such criteria in their publication, *Developing Vocational Instruction.*

Use of the systems approach was evident in only one of the curriculum development projects reviewed, *Oregon Statewide Study of Systematic Vocational Education Planning, Implementation, Evaluation: Phase I—Manpower Needs, Data-Collection Devices and Occupational Clusters. Final Report* (1967). In addition, the only study related to transportation occupations in which behavioral objectives were used was *A Study of the Comparative Teaching Efficiency of a Multi-median Instructional System Versus the Traditional Lecture Method for Youth Who Have Academic and Socioeconomic Handicaps* (1968). Because of this lack of emphasis on objectives, educators should give additional consideration to the criteria for such objectives as suggested by Mager (1962) in his book, *Preparing Instructional Objectives.*

The consideration of selection criteria appears to be of extreme importance in transportation occupations. While material was reviewed concerning general occupational information such as the *Job Guide for Young Workers, 1969-70 Edition* (U.S. Department of Labor, n.d.), *Occupational Outlook Handbook, 1970-71 Edition* (U.S. Department of Labor, n.d.), and *Aviation—Where Career Opportunities are Bright, Counselors Guide* (Zaharevitz, 1968), no specific selective criteria were located. Because of this apparent lack of materials, efforts should be made to develop and distribute items with specific criteria for the various occupations for student, counselor, and teacher use. Criteria should be prepared for high school, adult, and disadvantaged students in an effort to promote entry of individuals into transportation occupations.

Simulation

Utilization of the several analyses and the systems approach represents an effort to provide realistic occupational education. Realism has long been recognized for its importance in education for the transportation

occupations. But while it is important, the high cost of equipment and facilities, the space required for realistic training, and difficulty in creating realistic conditions in training situations have prevented the most efficient use of realistic situations. One possible method which could be used to alleviate this situation is simulation. Simulation, as defined by Tansey and Unwin (1968), is the creation of a situation which could occur in real life, usually with the variables simplified, for the purpose of instruction. Such simulation would help to bridge the gap between practical knowledge and purely theoretical knowledge and make training available to a greater number of people, including those in minority groups.

Several uses of the simulation technique were identified during the review of literature for this analysis. The report of Hall and his associates (1967) indicated that better use could be made of pilot training simulators if definite objectives and proficiency standards were established and used in assessing student progress. Finch (1969) reported that simulators could provide troubleshooting instruction in automotive mechanics courses, which is equal to that afforded by actual equipment, in less time. Rozran (1968) also used a simulator in his auto mechanics instructional system study but failed to obtain significant results. One railroad has begun using a computerized mock diesel engine cab to help train new engineers or serve as a refresher course for veteran engineers (*Columbus Dispatch,* August 10, 1970). It is evident that even broader use could be made of the simulation technique in all transportation occupations. However, its use probably will continue to be limited during the 1970's because of its relatively high cost in its more sophisticated forms.

Broad Training Base

Most of the curricula reviewed were prepared for narrow occupational categories even though efforts have been made to employ the cluster concept in preparing curricula for vocational education programs in transportation occupations. Efforts were made to cluster tasks in the *Oregon Statewide Study of Systematic Vocational Education Planning, Implementation, Evaluation: Phase I—Manpower Needs, Data-Collection Devices and Occupational Clusters. Final Report* (1967) while Ullery and Forsyth (1969) have promoted the use of core curricula in such training programs. Under this core concept, students enrolled in the program would receive a broad base of training which would help make them mobile and flexible in a job situation and provide increased employment opportunities and opportunities to grow (Maley, 1966).

A possible result of the employment of the core concept is vertical mobility or initiation of the "ladder concept." This is important so that trainees will not necessarily end up in dead-end positions or without jobs, but will have the opportunity to advance or seek other employment.

Curriculum Materials

Curriculum materials have been given a great deal of consideration in publications such as *Automotive Mechanic Entry* (U.S. Department of

Health, Education, and Welfare, 1969) and *Auto Body and Fender Repair* (1969), but more emphasis should be placed in this area. This is important, for while most educators know how to use media such as projectors, tape recorders, and television systems, few know when they should be used (Finn and Others, 1967). Instruction should be planned as a system in incorporate all of the media considered appropriate into a process which will result in the most efficient and effective learning.

Little consideration appears to have been given to programmed instructional materials for transportation occupations. Because of this, it is recommended that programmed instruction be integrated into formal training programs because it reportedly conserves instructional time, provides for flexible scheduling, and aids in standardizing content. Research involving the use of such materials generally has shown that this method can be an effective part of the teaching-learning process.

Methodology of Curriculum Development

The need for educational programs, the availability of curricula and curriculum materials, and the techniques of curriculum development for transportation occupations have been examined in the previous sections of this review and analysis. With this as a basis, one can make a prediction as to how curricula will be developed to prepare workers for their initial occupational roles and to update their skills and knowledge once they have entered an occupation.

It is possible and very probable that research being conducted at the present time will help to answer questions related to this preparation as they occur. However, the literature reviewed during the preparation of this analysis contained little material related to current projects of interest concerning curriculum development in transportation occupations. This does not mean that many projects were not being conducted but that such projects were of local interest or simply not reported in the literature reviewed. The only current research which was identified in relation to this analysis was a study, *Expansion of Vocational-Technical School Programs to Accommodate Highway Safety Manpower Requirements* (1970), being conducted by staff members of The Center for Vocational and Technical Education, The Ohio State University.

Analyses for Curriculum Development

Even without much research, it is possible to formulate procedures for the development of curricula which will keep pace with changes in transportation occupations. As a basis for such development, one must consider that "a realistic, functional curriculum depends upon an understanding of the needs and requirements of the occupational field. Determination of the elements of the occupation (the skills, knowledge, habits, and attitudes essential to employment) demands an occupational analysis" (Larson and Blake, 1969). Thus, some type of analyses will be used as the

primary means of providing the data necessary for curriculum development. The use of these analyses is possible because "occupational education is based upon the premise that the factors contributing to success in an occupation are relatively well-known and can be converted into certain educational experiences" (Roney in Larson and Blake, 1969).

Such analyses will be expanded to create a zoned analysis of the occupation. According to Larson, zoned analysis is a method of graphic delineation which may be explained as a system through which factors involved in any organization or research project may be arranged in orderly sequence on an easy-to-understand chart (Larson and Blake, 1969). Such an analysis proceeds from the general to the specific according to a predetermined and definite plan. One example of this type of analysis in the transportation occupations can be found in Crawford's (1969) publication, *A Competency Pattern Approach to Curriculum Construction in Distributive Teacher Education.* A zoned analysis of service station jobs is presented in Appendix B of her publication.

This technique can aid the developer in preparing curricula for various employment levels within an occupation or in preparing a total curriculum which employs the "ladder concept." This latter curriculum would have multi-exist points and contribute to worker mobility within an occupational area.

How can one analyze a job which is just emerging? Such a situation requires the complete cooperation of personnel in education and transportation occupations for the analysis should begin as the change is introduced. Priore (1968) indicated that when the normal training patterns are disrupted by new processes, industry continues to fall back on on-the-job training. The innovation is demonstrated to the operator who then perfects the requisite skills while performing the job. This procedure is assumed to be true for innovations in transportation occupations.

For the educator to analyze the job during this introductory period, a communications network must be established and maintained with transportation personnel. Because the introduction fo change is a highly variable process, a system should be developed to monitor the occupation involved in an effort to detect change. If curricula were prepared on a national basis or even a state basis and then revised for relevance to students in a given school, such a monitoring system would be feasible.

It might be possible for educational specialists to develop this type of communications network by becoming involved in helping industry personnel identify the job descriptions for emerging occupations. However, it is doubtful if such an analysis can begin until the job has actually been established. An attempt to generate job descriptions with the cooperation of job incumbents and supervisory personnel of related jobs proved to be inadequate (*Oregon Statewide Study of Systematic Vocational Education Planning, Implementation, Evaluation: Phase I—Manpower Needs, Data-Collection Devices and Occupational Clusters. Final Report,* 1967).

Systems Approach

Regardless of where the curriculum is developed, one of the analyses will not be the sole basis for its development. The analyses described earlier will be incorporated into a systems approach.

Once the analysis is completed, performance objectives similar to those suggested by Mager (1962) and recommended by Tuckman (1969) will be formulated. Then the educational strategy to meet these objectives will be fixed along with selection criteria for the students (Miller, 1969). These selection criteria are important as the curriculum should be designed for the types of persons as well as for the job or job cluster. In fact, Kurth stated that occupational analysis has two broad elements—competencies the worker has or brings to the job and competencies the occupation requires (Larson and Blake, 1969).

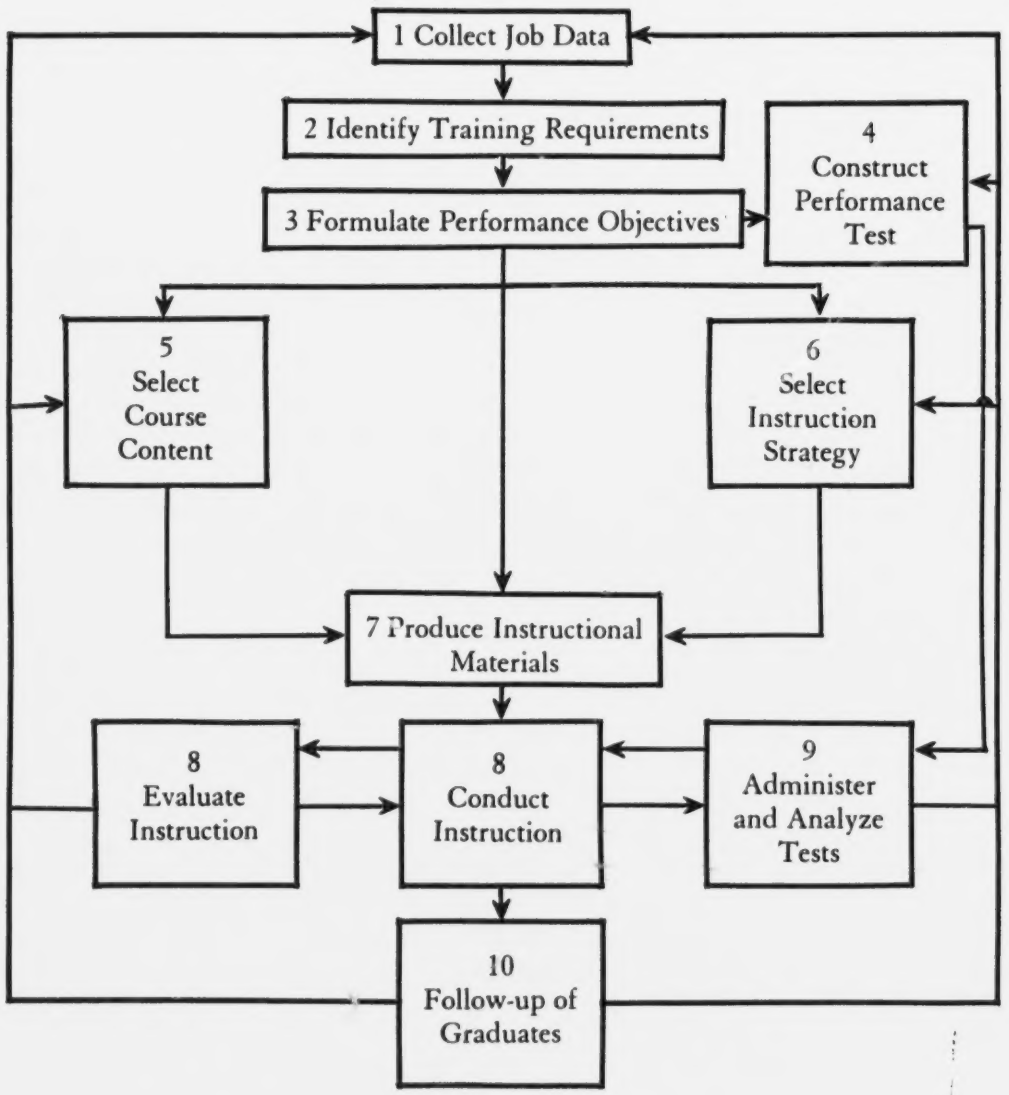
One systems approach to preparing students for an occupation is shown in Figure 2. This system includes provisions for the presentation and evaluation of instruction in addition to steps necessary for actual curriculum development. These additional steps, as should be noted from the arrows, are of value because they provide a feedback of information which may be used for curriculum improvement. In this system, the developers considered the type of student entering the program as part of step 6, select instruction strategy. The use of such a system in planning and conducting an educational program should lead to efficiency in training and better prepared individuals while it provides a means of constantly updating the training program. If such an approach is used, it should be designed to meet the requirements of the immediate situation.

Educational Curricula and Curricula Materials

Curricula must be developed to prepare potential workers for existing occupational opportunities as well as new and emerging occupational opportunities. They must be designed to cope with the changes taking place in transportation occupations and the mobility of transportation workers. Kurth has indicated that spiral curricula which ensure continuity and sequential learning of subject matter related to the students' interests and needs are of value (Larson and Blake, 1969). Such curricula may use multi-exist points so the students can leave the program with various skill and knowledge levels and then reenter the program to secure additional job preparation. Under this system, initial preparation will be provided in a cluster of occupations while training will become more specific as job placement approaches.

Instructional packets which include a curriculum, transparencies, equipment lists and specifications, supplies, budgets, a bibliography, and current reference material should be prepared. Such preparation and packaging is especially important for those occupations with fewer workers and in which few materials are available and few training programs are provided. In addition, an evaluation process should be devised to ensure

FIGURE 2
A SYSTEMS APPROACH TO OCCUPATIONAL TRAINING*



* W. R. Tracey, E. B. Flynn, and C. L. J. Legere, "Systems Approach Gets Results," *Training in Business and Industry,* IV (June 1967), pp. 17-21, 32-38.

the value of these materials and to determine the value of materials already available.

In the preparation of these materials, consideration should be given to the use of media such as television systems, computers, projectors, tape recorders, and simulators, and how they can contribute to the educational program. Such techniques as individually paced or programmed instruction also require consideration in future training programs.

Counseling Students

Counselors should have data which will indicate the degree to which aptitudes and interests of students are similar to those of individuals who have completed a given trade or industrial curriculum as well as persons who have successfully pursued related occupations for several years and have shown a reasonably good level of job proficiency (Doerr and Ferguson, 1968). This statement is applicable to transportation occupations, for Stewart (1968) has shown that persons engaged in certain transportation occupations and their training programs possess similar characteristics. Such data will increase in value as changes occur within the occupations and a means of providing this type of information and keeping it current should be established within the educational community.

Performance proficiency measurements and standards should be considered as requirements in the educational program. Proficiency measurements will provide a means of measuring student progress or the lack thereof and serve as a basis for counseling. Proficiency standards would help in determining the degree to which the student has achieved skills and knowledge necessary for entry into and performance in an occupation. Such measurements and standards are expected to play an important role in preparing training programs for minority groups.

Summary

An efficient and progressive transportation system is a goal that cannot be realized if serious shortages of trained transportation personnel occur. In trying to alleviate these shortages, it is unreasonable to expect a neat balance between training completions and job openings. While educators and transportation personnel should attempt to train enough workers to fill the positions, primary emphasis should be directed toward preparing the individual for work. To do this, a curriculum based on some type of work analysis and student interests and needs is required.

Curricula for the new and emerging occupations will be developed and evaluated through an educational planning system. This planning will involve four major steps: occupational analysis, program planning, program development and testing, and documentation and dissemination of the results (Roney, 1967). Based on an analysis of the material reviewed for this analysis, it appears that personnel interested in transportation education have not been able to perform these steps in a satisfactory manner. While

curricula and curriculum materials generally are available for certain occupations, improvements are needed and changes will be necessary. System changes necessary for the future involve placing additional emphasis on each of the four steps and employing stricter controls and guidelines. Special consideration should be given to analyzing the occupation and dissemination of the results.

New curricula alone are not enough. To provide and prepare the necessary workers, improved recruiting and counseling materials will be required along with improved uses of curriculum materials and teaching techniques. Efforts must be made to attract members from all segments of our society to meet future worker requirements. Additional research should be conducted to relate technological change and the responsiveness of transportation education curricula to this change.

In addition to these improvements, other changes must be made. Presently operating programs should be expanded and improved to meet future worker needs. Cooperative work-study programs and post-high school programs related to transportation occupations should be expanded as rapidly as possible. Efforts should be made to increase the number of high school programs providing educational experiences related to these occupations and to improve their effectiveness.

No educational system can supply the relevant level of skills and competence required without receiving active feedback and support from persons associated with the related occupation (Kraft, 1969). Because of this, a systems approach should be used not only in developing curricula but also for providing instruction. Future curriculum development and instruction requires that a complete and flexible communications network be established among all those affected by the educational program.

DESCRIPTION OF THE BIBLIOGRAPHY

Compilation

References believed to be of value to persons desiring information concerning curricula for transportation occupations were identified through a search of both Educational Resources Information Center (ERIC) publications and non-ERIC publications. ERIC publications included:

Abstracts of Instructional Materials in Vocational and Technical Education (AIM), Fall 1967—Spring 1970.

Abstracts of Research and Related Materials in Vocational and Technical Education (ARM), Fall 1967—Summer 1970.

Current Index to Journals in Education, Volume I; Volume II, Numbers 1-3.

Manpower Research: Inventory for Fiscal Years 1966 and 1967.

Manpower Research: Inventory for Fiscal Year 1968.

Research in Education (RIE), Volumes I-IV; Volume V, Numbers 1-7.

The three non-ERIC sources of information which were searched were:

CIRF Abstracts. Geneva, Switzerland: The International Vocational Training Information and Research Centre, C/O The International Labor Organization, Volumes I-VIII; Volume IX, First Dispatch (February 1970).

Corplan Associates of IIT Research Institute. *A Bibliography of Published and Unpublished Vocational and Technical Education Literature.* Illinois: Research Coordinating Unit, Vocational and Technical Education Division and State of Illinois, Board of Vocational Education and Rehabilitation, June 1966.

Ehrenreich, Julia W., ed. *Education Index.* New York: The H. W. Wilson Company, July 1964-May 1970.

While some of the later *Research in Education* indexes were searched manually by the writer, most were searched by computer. The remaining publications were searched manually by senior-level staff of The Center for Vocational and Technical Education, The Ohio State University, and/or by the writer. ERIC descriptors and strategies adapted from the *Thesaurus of ERIC Descriptors* and used in the searches are outlined below:

Curriculum	*and*	*Aircraft Pilots*
or Educational Needs		or Auto Body
		or Auto Mechanics
or Employment Qualifications		or Aviation Mechanics
		or Motor Vehicle
or Instruction		or Navigation
		or Traffic
or Job Skills		or Transportation
		or Travel

An additional search was made of the *Research in Education* indexes by computer and manually by the writer to identify material related to curricula development for transportation occupations. ERIC descriptors and strategies adopted from the *Thesaurus of ERIC Descriptors* and used in the search were:

Curriculum Design	*and*	*Cooperative Education*
or Curriculum Development		or Industrial Education
or Curriculum Planning		or Job Training
		or Technical Education
		or Vocational Education

In addition to these searches of specific sources, a cursory search was made of related materials available in the library of The Center for Vocational and Technical Education.

Organization

The bibliography prepared as a result of these searches was organized into two sections, literature identified from ERIC publications and that

identified from non-ERIC publications. Items identified through the cursory search of library materials were placed into one of these sections on the basis of whether they were listed in the ERIC publications reviewed earlier. If the materials identified were not listed in these publications, they were classified as from non-ERIC publications.

These sections were then divided into five subsections for ease of use. Items listed in each of these subsections were arranged alphabetically by author or title. The five subsections selected were:

Need for educational programs—Materials cited in this section contain information related to the need for trained manpower in transportation occupations and the types of programs through which training is provided.

Curricula and curriculum materials—This section includes citations which concern education in transportation occupations. These citations include material concerning program descriptions, student needs, course content, references, and instructional materials suitable for secondary and post-secondary programs.

Curriculum development—Documents listed in this section are those which deal with or are related to some aspect of curriculum development in transportation occupations such as related research reports and projects and needed revisions.

Methodology of curriculum development—This section of the bibliography contains documents concerning the procedures or methods and projects which have applicability to curriculum development for transportation occupations that will be important during the next decade.

Information sources—Publications cited in this section are those which were searched in an attempt to identify relevant material or which contain information of a general nature related to transportation occupations.

While the bibliographic entries were placed into these categories, such categorization is not meant to be exclusive. The various publications were listed in only one category, not in several categories. Because of this, references in categorical areas related to one's area of primary interest should be consulted for possible additional information.

Entries were selected on the basis of a limited review for their applicability to curricula for transportation occupations. It is believed that the entries included in the bibliography are representative of materials available in relation to this topic and will provide a basic orientation to transportation occupations. Yet, it must be realized that a truly complete search was not within the scope of this report. Many non-educational sources, including those prepared by military and industrial organizations, were not included in the basic search.

Availability of Documents

Publications and documents identified as pertinent to this review and analysis and listed in the bibliography may be secured through many sources. However, for easier access to these items, certain sources should be considered.

ERIC publications from which literature was identified may be determined by the prefix to the identifying document number. Prefixes found in this bibliography are:

Prefix	*Publication*
ED	RIE
MP	Manpower Inventory
VT	AIM, ARM

Most ED and MP documents are available on microfiche (MF) or hard copy (HC) from the ERIC Document Reproduction Service (EDRS).

EDRS prices cited in this bibliography reflect pricing in effect at the time of publication. Recent price schedules and ordering information available in the current issue of *Research in Education, AIM,* or *ARM* should be consulted prior to placing an order.

Items with a VT prefix can generally be found on microfiche in a VT-ERIC set which is available in many libraries or which may be ordered from EDRS. ED, MP, and VT items not available on microfiche or hard copy from EDRS may be secured from another source which is listed in the bibliography.

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